MULTICHIP MODULE HIGH SPEED TESTING

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Progress in the testing of multichip module electronic circuit packages for the period Oct. 1, 1992 - Dec. 31, 1992 is described below, in the areas of the testing of multichip modules using electrooptic polymers and the testing of high-speed transmission line structures.

Electrooptic Polymers

Work is proceeding on the testing of high-speed circuits using poled electrooptic polymers. Coplanar electrodes with thin layer (3 μm) coatings of a copolymer system, disperse red #1 on a methyl methacrylate backbone, have been obtained from AlliedSignal. The samples were poled at their glass transition temperature of 132°C at a poling field of 0.50 MV/cm. The response was measured in transmission mode through the electrode gap using a Ti:sapphire laser and a lock-in amplifier. The electrooptic response of these polymer layers, in relevant units, is approximately $2 \times 10^{-5}\ V_{det}\ mW^{-1}\ V_{signal}^{-1}$, where V_{det} is the detector output voltage and V_{signal} is the coplanar electrode bias voltage. This improved electrooptic response reflects improvements in the poling of the polymer layer, as well as reduced scattering losses in the inter-electrode gap. For a 16 V bias and 2 mW of optical power at a wavelength of 810 nm, for example, we detect a response of 500 μV. Earlier measurements of these polymers have suggested that the time response of the induced electrooptic effect is, for our purposes, nearly instantaneous, so the bandwidth of the response should be limited only by the response of the differential photodetection system.

The utility of this nearly non-invasive electrooptic sampling scheme would be greatly enhanced by the ability to measure signals in real time, rather than by lock-in techniques or signal averaging. The noise in the measurement at this time is dominated by the laser intensity noise; however, we are currently attempting to subtract this noise by a differential beam-splitting detection scheme (see Fig. 1). We are also hoping to improve signal levels by the use of thicker electrooptic polymer layers and improved poling techniques which will reduce scattering losses in the polymer. Future experiments will also employ a 780 nm diode laser, which may offer the possibility of multi-channel MCM testing using these electrooptic polymers, and the use of corona poling methods, which may be more compatible with MCM testing.

Skin Effect Measurements/High Speed Transmission Line Measurements

A transmission line structure consisting of Au on GaAs has been fabricated for the testing of the dispersion of such structures at high (> 1 GHz) frequencies. The coplanar structure consists of 10 μm wide Au stripes at 10 μm spacings, with the ground electrode interspersed with sampling electrodes (see Fig. 2). The design rules are that of high-speed transmission lines being tested at IBM. The metallization is a Au/Ge first layer, for ohmic contact to the n-GaAs, topped with pure Au. The GaAs has been damaged by ion implantation to reduce the carrier lifetime. Very short (psec) pulses may be launched into the transmission line by optical pulse techniques, and the waveform at various points along the line sampled by similar optical pulses at various delays.

We have presently fabricated several metallization thicknesses, corresponding to several different metal thickness/skin depth ratios. Since it is possible to use metallizations other than Au (Cu, for example, could be plated on top of the thin Au/Ge contact layer), this method will also permit the direct comparison of several different transmission line metallization schemes.

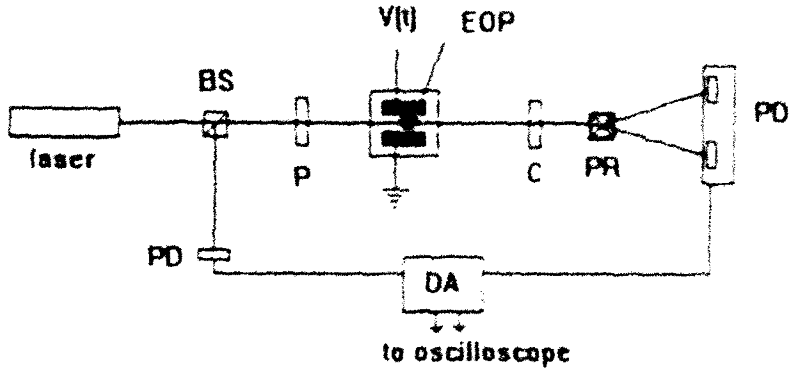

Figure 1. A differential photodetection scheme for the subtraction of laser intensity noise for the detection of signals from electrooptic polymers. BS - beam splitter; PD - photodiode; P - polarizer; PR - Wallaston prism; C - compensator; EOP - electrooptic polymer; DA - differential amplifier/subtractor.

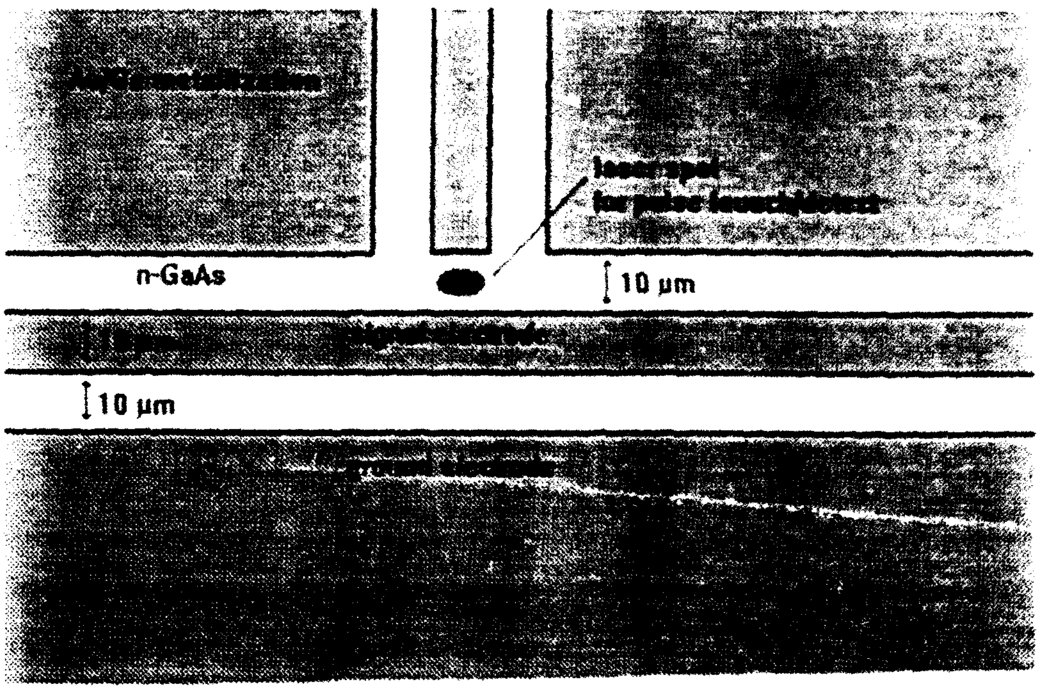

Figure 2. A coplanar transmission line with side electrodes for pulse application and sensing using optical delay methods. The Au/Ge metallization serves as an ohmic contact to the n-GaAs substrate, which is ion implanted in the open regions to serve as an optical switch.